



VALVE DEVICE FOR A PNEUMATIC SUSPENSION UNIT OF A VEHICLE

BACKGROUND OF THE INVENTION

The present invention relates to a new valve device for a vehicle air-suspension system.

A valve device of the general type under consideration is described in DE 4202729 A1. Air-suspension systems for vehicles are usually provided with a device for regulating the level of the vehicle body relative to the chassis or to the roadway. As regards such level-regulating devices, a distinction is made between level-regulating devices that operate purely mechanically by means of an air-suspension valve and electronically-controlled level-regulating devices. A mechanically-controlled level-regulating device containing an air-suspension valve is known, for example, from DE 4202729 A1. An example of a known electronically-controlled level-regulating device can be found in EP 0779167 B1.

In mechanically-controlled level-regulating devices having an air-suspension valve, a manually actuatable valve, also referred to as a rotary slide valve, is usually provided in addition to the air-suspension valve. By means of the rotary slide valve, an operator can bypass the air-suspension valve and adjust the desired relative level of the vehicle body manually by placing the rotary slide valve in the "raise", "lower" or "stop" positions. In this way, the relative level needed, for example, for loading the vehicle at a loading dock, can be achieved. The rotary slide valve may also be provided with a "travel" position, in which the air-suspension valve becomes active once again. An electromagnetically actuatable valve may also be provided for resetting the manual valve from the "stop" position to the "travel" position.

SUBSTITUTE SPECIFICATION

In electronically-controlled level-regulating devices, control of the relative level takes place in any case via electromagnetically actuatable valves, both in the case of electronic regulation of the relative level and in the case of manual adjustment via an electrical operating unit.

Despite advantages of electronically-controlled level-regulating devices over mechanically-controlled level-regulating devices, such as considerably better regulation comfort and greater driving safety by virtue of refined regulation algorithms, air-suspension valves associated with mechanically-controlled level-regulating devices are still being used for cost-saving reasons.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the present invention a new valve device for a vehicle air-suspension system is provided that can be used simply and inexpensively in both mechanically-controlled level-regulating devices and electronically-controlled level-regulating devices. The valve device according to a preferred embodiment of the present invention includes a manually actuatable aeration valve for aerating the air-suspension bellows of the air-suspension system, a manually actuatable bleed valve for bleeding the air-suspension bellows, and a first electrically actuatable valve. The aeration valve, bleed valve and first electrically actuatable valve are disposed in a common housing. A second electrically actuatable valve is also disposed in the housing.

Advantageously, the present invention offers an inexpensive, universal solution for both mechanically-controlled level-regulating devices and electronically-controlled level-

regulating devices. The present invention can be manufactured as a compact valve block, which can either be sold separately or as a compact electronic level-regulating unit combined with an electronic control device. The cost benefit of the present inventive valve device over conventional valve devices for level-regulating devices is achieved in series production whereby the inventive valve device can be manufactured in relatively high output volume by virtue of its universal applicability.

An additional advantage of the present invention is that a vehicle equipped with the inventive valve device as well as with an air-suspension valve can be retrofitted with relatively minimal time and effort with an electronically controlled level-regulating device. For this purpose, the inventive valve device is retained, but the air-suspension valve is replaced by a displacement sensor for sensing the relative level of the vehicle body. Furthermore, the inventive valve device can be connected electrically to an electronic control device. Usually, the electronic control device is already present in the vehicle, for example, in the form of an electronics module for an anti-brake-lock system, and has connections appropriate for the inventive valve device and the displacement sensor.

For application of the inventive valve device in an electronically controlled level-regulating device, a further advantage is that manual operating elements are already provided for admitting air into and venting air from air suspension bellows, or in other words for manually changing the relative level of the vehicle body. As a result, manual change of relative level is possible even in the absence of power supply to the electronically controlled level-regulating device. A further advantage in this regard is that there is no need, especially for trailer vehicles,

to provide an on-board battery or to externally supply a parked trailer vehicle with power by some other means in order to change the relative level manually, for example, at a loading dock.

For application of the inventive valve device in a mechanically-controlled level-regulating device, an additional advantage exists in that there is already provided an electrically actuatable valve, by means of which the regulating function of the air-suspension valve can be turned off, for example when the vehicle is stationary, in order to permit a manual change of the relative level. The electrically actuatable valve also allows the air-suspension valve to be reactivated when the vehicle starts to travel once again, thus ensuring a relative level that is safe for driving operation of the vehicle.

According to one embodiment of the present invention, a relay valve is further provided. Relay valves can be manufactured relatively inexpensively, and they offer a large flow cross section for admission of air into and venting of air from the air-suspension bellows, thus permitting relatively rapid changes of relative level. According to an embodiment of the present invention, the relay valve is disposed in the housing of the inventive valve device enabling compact construction of the valve device. An advantage of this construction is that separate compressed-air lines to the relay valve do not have to be used during installation of the present inventive valve device in the vehicle.

According to another embodiment of the present invention, a contactless operating displacement sensor for sensing the distance of the inventive valve device relative to the roadway is further provided and disposed in the housing. The displacement sensor can be configured as an ultrasonic sensor, a radar sensor or a sensor operating according to the light-reflection

principle. Because the displacement sensor is disposed in the housing of the inventive valve device, which is usually mounted on the vehicle frame, the sensor is already mounted at a location suitable for transmitting a signal characteristic of the relative level of the vehicle body. Thus, there is no need to separately mount and provide cables to the displacement sensor.

Still other objects and advantages of the present invention will in part be obvious and will in part be apparent from the specification.

The present invention accordingly comprises the features of construction, combination of elements, and arrangements of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in more detail hereinafter on the basis of the accompanying drawings, in which:

Fig. 1 is a schematic diagram depicting a vehicle air suspension system employing a valve device according to one embodiment of the present invention in an electronically-controlled level-regulating device;

Fig. 2 is a schematic diagram depicting a vehicle air suspension system employing the valve device according to Fig. 1 in a mechanically-controlled level-regulating device;

Fig. 3 is schematic diagram depicting a valve device according to another embodiment of the present invention; and

Fig. 4 is a schematic diagram depicting a valve device according to a further embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing figures, where like reference numerals are used for parts corresponding to one another, Fig. 1, shows a vehicle air-suspension system provided with air-suspension bellows (3), which brace the vehicle body relative to the wheels (4) or to the axles of the vehicle. The air-suspension system is also provided with an electronically controlled level-regulating device (1, 5, 22, 23), which, for admission of air to air-suspension bellows (3), controls a compressed-air supply flow from a pressurized-fluid source (2) in communication with the level-regulating device to air-suspension bellows (3), and, for venting of air-suspension bellows (3), controls a compressed-air discharge flow from air-suspension bellows (3) to the atmosphere.

Electronically controlled level-regulating device (1, 5, 22, 23) is provided with an electronic control device in the form of an electronic control unit (5), which can be supplied by an electrical energy source (not shown). From a displacement sensor (22), which is used to measure the distance of the vehicle body from a reference point relative to wheels (4) and to determine the relative level of the vehicle body, electronic control unit (5) receives a relative-level signal via an electrical line. Displacement sensor (22) can be configured, for example, as an ultrasonic sensor, a radar sensor or a sensor operating according to the light-reflection principle.

Furthermore, electronic control unit (5) receives a pressure signal from a pressure sensor (23), via an electrical line. Pressure sensor (23) is in communication on the pressure side with air-suspension bellows (3). Thus, the transmitted pressure signal indicates the air pressure

present in air-suspension bellows (3).

Electronic control unit (5) is connected via electrical lines (8, 9) to a valve device (1). Valve device (1) is provided with a housing (55) in which there are disposed a manually actuatable air-admission valve (10) for admission of air to the air-suspension bellows (3), a manually actuatable vent valve (11) for venting air-suspension bellows (3), a first valve (7) that can be electrically actuated via line (9) and a second valve (6) that can be electrically actuated via line (8). Electrically actuatable valves (6, 7) can be actuated using electronic control unit (5) by energizing electromagnets (20, 21) via electrical lines (8, 9), respectively.

According to an embodiment of the present invention, housing (55) is provided with separate compressed-air ports (52, 54) for supplying compressed air from a pressurized-fluid source (2) to electrically actuatable valves (6, 7) on the one hand and to manually actuatable valves (10, 11) on the other hand. As a result, valve device (1) is flexible as to varying uses.

For use of valve device (1) in an electronically-controlled level-regulating device such as illustrated in Fig. 1, compressed-air ports (52, 54) are in communication with one another. For this purpose, first electrically actuatable valve (7) is in communication with pressurized-fluid source (2) via compressed-air port (52). Furthermore, manually actuatable air-admission valve (10) is in communication with pressurized-fluid source (2) via compressed-air port (54).

In accordance with another embodiment of the present invention, electronic control unit (5) as well as pressure sensor (3) is also disposed in housing (55). As a result, a

compact electronically-controlled level-regulating device, which can be installed with minimal time and effort in a vehicle, is provided. According to a further embodiment of the present invention, displacement sensor (22) is also disposed in housing (55), further reducing the time and effort needed to install the level-regulating device in the vehicle.

Using predefined algorithms, electronic control unit (5) determines whether the measured relative level of the vehicle body would necessitate admission of air to or venting of air from air-suspension bellows (3) in order to maintain a desired index relative level. By actuating electrically actuatable valves (6, 7), electronic control unit (5) supplies air to or vents air from air-suspension bellows (3) as needed, in order to adapt the relative level measured by displacement sensor (22) compared to the index relative level.

Valve (6), which in a preferred embodiment is designed as a 3/2 directional control valve, is used as a combined inlet/outlet valve, which assumes an inlet position in the de-energized state of electromagnet (20), as illustrated in Fig. 1, and an outlet position in the energized state of electromagnet (20). Valve (7), which in a preferred embodiment is designed as a 2/2 directional control valve, is used as a holding valve, which assumes a shutoff position in the de-energized state of electromagnet (21), as illustrated in Fig. 1, and a passing position in the energized state of electromagnet (21). For admission of air to air-suspension bellows (3), electronic control unit (5) switches inlet/outlet valve (6) to inlet position and switches holding valve (7) to passing position. As a result, pressurized-fluid source (2) is placed in communication with air-suspension bellows (3), so that compressed air can flow from pressurized-fluid source (2) via compressed-air lines (13, 15, 17) and valves (6, 7) into air-

suspension bellows (3). For venting of air-suspension bellows (3), electronic control unit (5) switches inlet/outlet valve (6) to outlet position and additionally switches holding valve (7) to shutoff position. As a result, pressurized-fluid source (2) is shut off and air-suspension bellows (3) are placed in communication with a vent port of inlet/outlet valve (6) so that compressed air can flow from air-suspension bellows (3) via compressed-air line (17) and valve (6) to the atmosphere. To hold the air pressure present in air-suspension bellows (3), electronic control unit (5) switches holding valve (7) to shutoff position and inlet/outlet valve (6) to inlet position.

In the vehicle air-suspension system illustrated in Fig. 1, air-suspension bellows (3) may be controlled together to have the same pressure. Alternatively, it is possible to combine the air-suspension bellows into wheel groups or axle groups or even to control each air-suspension bellow individually. In the event that suspension bellows are not controlled all together, the electronically-controlled level-regulating device must be augmented by appropriate valves for individual control of the air-suspension bellows or the groups of air-suspension bellows.

In addition, the vehicle air-suspension system is further provided with two momentary-contact switches (18, 19) as manual actuating elements. By manual actuation of the momentary-contact switches (18, 19), supplying air to and/or venting air from air-suspension bellows (3) is possible even in the absence of power supply to electronically controlled level-regulating device (1) or to electronic control unit (5).

According to an embodiment of the present invention, valves (10, 11), which can be manually actuated via manual actuating elements (18, 19), are provided in a compressed-air

branch (12, 14, 16) parallel to and bypassing electrically actuatable valves (6, 7). Manually actuatable valves (10, 11) are preferably a pneumatic 2/2 directional control valve (10) and a pneumatic 3/2 directional control valve (11), respectively. Such directional control valves can be manufactured simply and inexpensively and are highly reliable in use.

According to an embodiment of the present invention, momentary-contact switches (18, 19) are mechanically connected to pneumatic directional control valves (10, 11). Via momentary-contact switches (18, 19), directional control valves (10, 11) can be actuated to counteract the force from a restoring spring. Directional control valve (10) then acts as an air-admission valve, which assumes a shutoff position in the non-actuated state of momentary-contact switch (18), as illustrated in Fig. 1, and an inlet position in the actuated state of momentary-contact switch (18). Directional control valve (11) then acts as a combined vent valve, which assumes a passing position in the non-actuated state of momentary-contact switch (19), as illustrated in Fig. 1, and a venting position in the actuated state of momentary-contact switch (19).

In the absence of power supply, the relative level can be manually changed by admitting air to or venting air from air-suspension bellows (3) as described hereinafter.

For air admission, momentary-contact switch (18) is manually actuated, whereby directional control valve (10) is switched to an inlet position. As a result, compressed air can flow from pressurized-fluid source (2) via compressed-air lines (12, 14, 16) through directional control valve (10) as well as through directional control valve (11), which is in passing position in the non-actuated state of momentary-contact switch (19), to air-suspension bellows (3). To

hold the air pressure or the relative level, momentary-contact switch (18) is released, shutting off the flow of pressurized fluid. For venting, momentary-contact switch (19) is manually actuated, whereby directional control valve (11) is set to a venting position. As a result, compressed air can flow out of air-suspension bellows (3) via compressed-air line (16) and via a vent port of directional control valve (11) to the atmosphere. To hold the air pressure or the relative level beginning from this state, momentary-contact switch (19) is released.

Referring now to Fig. 2, there is illustrated use of the valve device (1) in an air-suspension device containing an air-suspension valve (53). In this embodiment of valve device (1), compressed-air ports (52, 54) are not in communication with one another. Compressed-air port (52) is connected to air-suspension valve (53), which in turn is connected to pressurized-fluid source (2). Compressed-air port (54) is directly connected to pressurized-fluid source (2). As a result, it is possible to change the relative level manually by actuating momentary-contact switches (18, 19), as described above, while bypassing air-suspension valve (53).

Air-suspension valve (53) is in communication with the air-suspension bellows via electrically actuatable valves (6, 7). In this embodiment of valve device (1), electrically actuatable valve (7) is connected, via electrical line (9), to an electronic control device (5), which is an electronics module already present in the vehicle for other purposes.

As an example, electronics module (5) may execute the functions of an anti-brake-lock system and, for this purpose, is connected via electrical lines (51) to speed sensors (50) for measuring the speeds of revolution of wheels (4). The electronics module (5) is also connected to brake-pressure regulating valves (not shown). In addition, electronics module (5)

has connections appropriate for valve device (1) and displacement sensor (22). Electronics module (5) evaluates the signals of speed sensors (50) and extracts therefrom a signal indicating whether the vehicle is stationary or traveling. In the stationary mode, electronics module (5) switches electrically actuatable valve (7) to a shutoff position, thus disabling air-suspension valve (53). In the travel mode, electronics module (5) switches electrically actuatable valve (7) to a passing position, such that air-suspension valve (53) is placed in communication with air-suspension bellows (3) and can regulate the level of the vehicle body. Electrically actuatable valve (6) is not used in this application of valve device (1).

According to another embodiment of the present invention, electrically actuatable valves (6, 7) are directly and mechanically coupled with the manual actuating elements, which in this instance are momentary-contact switches (18, 19), and which can be manually actuated via the manual actuating elements. As a result, further improvements in terms of compactness and manufacturing costs of valve device (1) are achieved. In this case, valves (6, 7) can be actuated optionally by their momentary-contact switches (18, 19) or, alternatively, by electromagnets (20, 21). In either case, the valves are actuated to counteract against a spring force.

Fig. 3 depicts a further configuration of the air-suspension device illustrated in Fig. 1 and Fig. 2, however, only the part of the air-suspension device concerning valve device (1) is shown.

Referring now to Fig. 3, electrically actuatable valves are provided preferably as two 2/2 directional control valves (32, 33), which can be actuated by electronic control unit (5) via electromagnets (20, 21) and electrical lines (8, 9). Manually actuatable valves are further

provided as 2/2 directional control valves (34, 35), which can be manually actuated via momentary-contact switches (18, 19). Valves (32, 33, 34, 35) are in communication on the input side with compressed-air port (54), which is in communication with compressed-air source (2).

According to an embodiment of the present invention, a servo-valve device (30, 31) is additionally provided (Fig. 3) for admission of air to and/or venting of air from air-suspension bellows (3). Servo-valve device (30, 31) can be actuated by electrically actuatable valves (32, 33). In addition, servo-valve device (30, 31) can be manually actuated indirectly via compressed-air actuation by directional control valves (34, 35) of manual actuating elements (18, 19).

Servo-valve device (30, 31) includes 2/2 directional control valve (30) and 3/2 directional control valve (31), both of which can be actuated by pressurized fluid. Valve (30) acts as a holding valve and valve (31) acts as a combined inlet/outlet valve. The functions of valves (30, 31) correspond respectively to the functions of valves (6, 7) described above with respect to Fig. 1. In contrast to valves (6, 7), however, valves (30, 31) can be actuated by pressurized fluid via pressurized-fluid control inputs. The pressurized-fluid control input of holding valve (30) is in communication via its pressurized-fluid control input with pressurized-fluid outputs of valves (32, 34). The pressurized-fluid control inputs of inlet/outlet valve (31) is in communication with pressurized-fluid outputs of valves (33, 35). Via compressed-air line (13), valve (30) is in communication with compressed-air port (52), which may be in communication with compressed-air source (2) or with air-suspension valve (53), depending on the particular application.

Control of the relative level by appropriate action on electrically actuatable valves (32, 33) is as described above with respect to Fig. 1. Electrically actuatable valves (32, 33) act as pilot-control valves for valves (30, 31), respectively. For manual actuation, momentary-contact switch (18) is manually actuated for admission of air into air-suspension bellows (3), while momentary-contact switch (19) is manually actuated for venting air from air-suspension bellows (3). Valves (34, 35) also act as pilot-control valves for valves (30, 31), respectively. To supply air to air-suspension bellows (3), compressed-air flows from compressed-air source (2) via compressed-air lines (13, 15, 17) to air-suspension bellows (3). To vent air, compressed-air flows from air-suspension bellows (3) via compressed-air line (17) and a venting port of inlet/outlet valve (31) into the atmosphere.

In the case of application of valve device (1) containing an air-suspension valve (53), and when the vehicle is stationary, electronics module (5) switches valve (30) to shutoff position by non-actuation of electrically actuatable valve (32), disabling air-suspension valve (53). If the vehicle is in travel mode, electronics module (5) switches valve (30) to passing position by actuation of electrically actuatable valve (32), so that air-suspension valve (53) is placed in communication with air-suspension bellows (3) and can bring about regulation of the level of the vehicle body. Electrically actuatable valve (33) is not used in this application of valve device (1).

Fig. 4 illustrates a further embodiment of the inventive air-suspension device, showing only the part of the air-suspension device concerning the valve devices. Referring to Fig. 4 there is provided, as the servo-valve device, a relay-valve device (40), which outputs the

pressure present at a pressure-control input (43) to a compressed-air output (42) while maintaining the same pressure head. For the purpose of venting compressed air from air-suspension bellows (3) into the atmosphere, relay-valve device (40) is provided with a vent port. To supply compressed air to air-suspension bellows (3), relay-valve device (40) is in communication, by means of a pressurized-fluid input port (41) and via compressed-air line (13), with compressed-air port (54), which in all cases of application of valve device (1) is in communication with compressed-air source (2).

As illustrated in Fig. 4, the electrically actuatable valves are configured as a combined air-admission/holding valve (44), which is preferably a 3/2 directional control valve, and as a vent valve (45), which is preferably a 2/2 directional control valve. The valves can be actuated by electronic control unit (5), via electromagnets (20, 21). The manually actuatable valve device is also provided with combined air-admission/holding valve (46), which is preferably a 3/2 directional control valve, and a vent valve (47), which is preferably a 2/2 directional control valve. The valves can be manually actuated by momentary-contact switches (18, 19). By means of a pressurized-fluid input port, electrically actuatable air-admission/holding valve (44) is in communication with compressed-air port (52). By means of a pressurized-fluid input port, manually actuatable air-admission/holding valve (46) is in communication via compressed-air line (13) with compressed-air port (54). Via vent valve (45), vent valve (47), air-admission/holding valve (46) and air-admission/holding valve (44), pressure-control input (43) of relay-valve device (40) is looped back to compressed-air output (42) of relay-valve device (40). If electrically actuatable valves (44, 45) and manually actuatable valves

(46, 47) are not actuated, as illustrated in Fig. 4, pressure-control input (43) and compressed-air output (42) of relay-valve device (40) are in communication with one another. As a result, relay device (40) exerts a pressure-holding function such that the pressure present in compressed-air line (17) is held constant.

In the case of application of electronically-controlled level regulation, and air is to be admitted to air-suspension bellows (3), electronic control unit (5) performs the level-regulating functions by acting via electrical line (8) on electromagnet (20) to actuate valve (44). As a result compressed air is delivered from pressurized-fluid source (2) to pressure-control input (43). Relay-valve device (40) proceeds to adjust the pressure at compressed-air output (42) to that present at pressure-control input (43) using relay-valve device (40) to pass compressed air from pressurized-fluid input port (41) through to compressed-air output (42). If air-suspension bellows (3) are to be vented, electronic control unit (5) actuates electromagnet (21) via electrical line (9) in order to actuate valve (45). As a result, pressure-control input (43) of relay-valve device (40) is placed in communication with the vent port of vent valve (45) and therefore with the atmosphere. Relay-valve device (40) proceeds to adjust the pressure at compressed-air output (42) to that present at pressure-control input (43) using relay-valve device (40) to allow compressed air to flow out of air-suspension bellows (3) via the vent port of relay-valve device (40) into the atmosphere.

For manual change of the relative level, momentary-contact switch (18) is actuated to admit air into air-suspension bellows (3) and momentary-contact switch (19) is actuated to vent air from air-suspension bellows (3). The actuation of momentary-contact switch

(18) reverses air-admission/holding valve (46) such that pressure-control input (43) of relay-valve device (40) is placed in communication with pressurized-fluid source (2). In turn, relay-valve device (40) proceeds to adjust the pressure at compressed-air output (42) to the pressure present at pressure-control input (43) using relay-valve device (40) to pass compressed air from pressurized-fluid input port (41) through to compressed-air output (42). Actuation of momentary-contact switch (19) reverses vent valve (47) such that pressure-control input (43) of relay-valve device (40) is placed in communication with the vent port of vent valve (47). In turn, relay-valve device (40) proceeds to adjust the pressure at compressed-air output (42) to the pressure present at pressure-control input (43) using relay-valve device (40) to allow compressed air to flow out of air-suspension bellows (3) via the vent port of relay-valve device (40) into the atmosphere.

In the case of application of the mechanically-controlled level-regulating device containing an air-suspension valve, air-suspension valve (53) is connected to compressed-air port (52) in the embodiment according to Fig. 4. In this case, air-suspension valve (53) brings about level regulation by changing the pressure at pressure-control input (43) while valve (44) is switched to passing position.

According to an embodiment of the present invention, servo-valve device (30, 31, 40) is mechanically coupled with manual actuating element (18, 19) and can be manually actuated via manual actuating element (18, 19). In the embodiment of the servo-valve device according to Fig. 3, the manual actuating elements can be mechanically coupled with valves (30, 31) such that momentary-contact switch (18) is mechanically coupled with valve (30) and

momentary-contact switch (19) with valve (31). In the embodiment of the servo-valve device according to Fig. 4, the manual actuating elements can be directly coupled mechanically with relay-valve device (40). This means, for example, that they can act mechanically from opposite sides on a relay piston provided in relay-valve device (40).

According to an embodiment of the present invention, electronically controlled level-regulating device (1) is suitable for receiving at least one manually predefined input variable. The input variable can be predefined via manual actuating element (18, 19) even in the presence of power supply to electronically controlled level-regulating device (1). Such an input variable is preferably a manually predefined relative level or change of relative level compared with the previously adjusted relative level. This has the advantage that these same actuating elements can be used at any time to predefine the input variable, regardless of whether or not the level-regulating device is being supplied with electrical power. Additional actuating elements such as electric momentary-contact switches are not necessary. Furthermore, a simple kind of operator control is achieved because the operator does not have to actuate different operating elements based on the state of the power supply.

According to an embodiment of the present invention, electronically-controlled level-regulating device (1) is capable of receiving at least one distance signal from a displacement sensor (22) as well as one pressure signal from a pressure sensor (23). Level-regulating device (1) or electronic control unit (5) evaluates the distance signal and the pressure signal continuously, and on the basis of the variation of these signals detects whether an input variable such as a change of relative level has been manually predefined. In the process,

electronic control unit (5) advantageously checks whether the distance signal is changing while the pressure signal remains substantially constant. This is an indication of a manually predefined change of relative level such that a certain quantity of air has been discharged from or injected into air-suspension bellows (3) at substantially constant vehicle weight. Since it can be assumed during such a manual change of relative level that the vehicle cargo and therefore the vehicle weight remained constant, the pressure in air-suspension bellows (3) does not change as a result, but instead only the volume of compressed air stored therein is changed by a change in relative level. However, if the electronic control unit detects that the pressure signal and the distance signal are changing, this is an indication that the vehicle cargo has been changed. In this case, electronic control unit (5) does not read a manually predefined input variable.

The exemplary valve devices illustrated in Fig. 3 and Fig. 4 are both applicable in a mechanically-controlled level-regulating device and in an electronically-controlled level-regulating device.

According to an embodiment of the present invention, a rotary arm known from conventional rotary slide valves can be used instead of separate momentary-contact switches (18, 19). The rotary arm supplies air to air-suspension bellows (3) in one end position and vents air from air-suspension bellows (3) in another end position.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained, and since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying

drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is: